

Institute of Energy Technology – Professorship of Renewable Energy Carriers***Invitation to a Seminar***

Date: Friday, October 25, 2013
Time: 16:00-17:00
Place: Maschinenlaboratorium ETH Zürich, ML-J25/26

Speaker: **Dr. Roman Bader**
Mechanical Engineering
University of Minnesota, Minneapolis, USA
<http://www.me.umn.edu/labs/solar/index.shtml>

Title: CO₂ Splitting via Solar Thermochemical Redox Cycling of Ceria

Abstract – Solar thermochemical splitting of CO₂ and H₂O into syngas by utilizing the reducing power of partially or fully reduced metal oxides offers an efficient pathway to re-energize the main combustion products. Syngas can be used as a fuel, for example in solid oxide fuel cells, or further processed into liquid hydrocarbon fuels. In two-step processes, the metal oxide is first reduced at a higher temperature by using concentrated solar energy as the heat input, and then re-oxidized in the presence of the reactants (CO₂, H₂O) at a lower temperature. Benefits of using ceria as the reactive metal oxide include its high oxygen ion diffusivity and its high melting point, which avoids the need for a separation process to recover the metal oxide from the product gas mixture. On the other hand, ceria only undergoes partial reduction at temperatures up to 1500°C, which leads to large ratios of cycled mass of ceria to mass of produced fuel and hence to a significant energy penalty if the ceria undergoes a large temperature change during the process. To avoid these energy penalties, the non-stoichiometry of ceria can also be changed by applying a change in the oxygen partial pressure of the gas phase over the ceria.

In this seminar, we will review the potential of temperature swing and isothermal redox cycling of ceria for syngas production based on thermodynamic process analyses. Recent experimental results for isothermal cycling will be presented, and approaches to realize the isothermal cycle in a single solar reactor to continuously produce CO will be discussed.

Biosketch – Roman Bader received an MSc in Mechanical Engineering in 2008 and a PhD in 2011, both from the ETH Zurich. In 2012, he joined the Solar Energy Laboratory at the University of Minnesota as a postdoc. In November 2013, he will join the Solar Thermal Group at the Australian National University as a Research Fellow. His research interests are in the areas of thermal, thermochemical and numerical sciences and their application to energy and process technologies.



Host: Prof. A. Steinfeld, www.pre.ethz.ch